Testing a liquid lithium cooled beryllium target

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It is anticipated that up to 30% of the beam power will deposited in the RIA fragmentation target in an area as small as a 1 mm diameter spot. Hence, the power densities will be extremely high and can probably only be handled with liquid metal technology. Calculations performed by Nolen and collaborators at ANL show that a windowless liquid lithium target should be able to handle the beam power for the highest Z beams but such targets will be too thick to be useful for medium and low Z beams. We have setup an ANL-MSU collaboration to design and construct a sealed liquid-lithium cooled beryllium target system that will be able to dissipate one kW of thermal power. Following a lengthy design process including thorough safety analysis, the system is presently being constructed. The stand-alone device will be filled with lithium at Argonne, tested off-line at MSU, and then installed in the target position of the NSCL's A1900 projectile fragment separator. The beam will pass through a beryllium piece with thin walls (see photograph, below) that contain the liquid lithium. The beryllium windows on each side are tapered from 7mm to 1mm, the lithium flows through a 5mm channel. The beryllium metal provides the bulk of the target nuclei and absorbs most of the energy due to the low density of lithium (0.535 g/cm^3). We believe that operation of the sealed target represents both a big step toward the high power metal-cooled RIA targets that needs to be continued.

Figure 1 A photograph of the actual beryllium target piece. The liquid metal flows through an internal channel in the center of the piece from bottom to top. The beam would pass through the wedge-shaped region from left to right in this view.